SEATTLE CITY LIGHT

MATERIAL STANDARD

STANDARD NUMBER: **0035.5**

DATE: June 11, 1986
REV: March 22, 2002

POWER TRANSFORMER, 3-PHASE
26400 GRD.Y/15242 - 13800Y/7970

1. General

1.1 This specification covers three-phase power transformers for use on a 25,564 Grd.Y/14,760 volts, 60 Hertz distribution system. The transformers are intended for installation above ground on pads.

1.2 Transformers supplied under this specification shall meet the requirements of ANSI C57.12.10, except as modified herein.

1.3 The transformer shall have a buried tertiary winding with a capacity of 35% of the transformer rating with a voltage of the manufacturer's choice.

2. Rating

2.1 The transformer shall have the following kVA ratings.

Seattle City Light Stock No.	345588	345592	345594
Self-cooled at 55° C	5000	7500	10000
Self-cooled at 65° C	5600	8400	11200
With **provisions** for additional future cooling fans at 55° C	6250	9375	12500
With **provisions** for additional future cooling fans at 65° C	7000	10500	14000

2.2 The voltage rating shall be 26,400 Grounded Y/15,242-13,800Y/7,970 volts.

2.3 The impedance shall be per ANSI C57.12.10, Section 4.6 for 150 kV BIL (6.5%)

3. Insulation

3.1 The basic impulse insulation level (BIL) design shall be 150 kV for the high-voltage windings and 110 kV BIL for the low-voltage windings. Note: ANSI C57.12.10 designates 150 kV BIL for the 26 kV H.V. windings; however, the bushings will limit testing to 125 kV BIL.

3.2 The transformer shall be designed for a 55/65° C rise with provisions for future fans. This shall be stated both on the bid and on the nameplate.

4. Primary Bushings

4.1 Four 600 ampere primary bushings shall be **welded** on the end wall of the transformer in approximately the upper one-third of the tank. The bushings shall be rated 600 amperes, 125 kV BIL and shall be suitable for operation on a 25,564 Gr.Y/14,760-volt system. **Gasketed bushings are not acceptable.** The bushings shall be labeled H_0, H_1, H_2, or H_3 appropriately adjacent to each bushing. The bushings shall be mounted on a horizontal line a minimum of 9" to 12" apart. The end nut on the bushings inside the tank shall be 24" maximum (arm's length) from the handhole on the cover.

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4. Primary Bushings (Continued)

4.2 The bushings shall be Elastimold Apparatus Bushing K650S1 or K650T1. Other manufacturers' bushings may be acceptable provided (a) they are the welded-in type and, (b) certified test data are submitted showing that they are interchangeable with Elastimold K655 BLR elbow interfaces and electrical ratings. Bushings shall have a 5/8" threaded hole. Bushings with studs installed are not acceptable.

4.3 Each bushing shall have a cap to prevent the entrance of moisture or contamination during shipping and storage. The bushings shall be protected against damage during shipping and temporary storage with a wood or metal cover that is securely fastened to the transformer.

4.4 One parking stand (four total) shall be welded on the wall near each bushing, complete with stainless steel or copper-faced steel ground pads with a 1/2"-13 NC tapped hole, 7/16" (11 mm) deep. The threads shall be coated with oxide-inhibiting compound. The parking stand shall accommodate an Elastimold K650 SOP standoff plug.

5. Secondary Bushings

5.1 Four 600 ampere secondary bushings shall be **welded** on the end wall of the transformer in approximately the upper one-third of the tank. The bushings shall be rated 600 amperes, 125 kV BIL* and shall be suitable for operation on a 13,800 Grd.Y/7970-volt system. **Gasketed bushings are not acceptable**. The bushings shall be labeled X_0, X_1, X_2, or X_3 appropriately adjacent to each bushing. The bushings shall be mounted on a horizontal line a minimum of 9" apart. The end nut on the bushings inside the tank shall be 24" maximum (arm's length) from the handhole on the cover.

5.2 The bushings shall be Elastimold Apparatus Bushing K650S1* or K650T1*. Other manufacturers' bushings may be acceptable provided (a) they are the welded-in type, and (b) certified test data are submitted showing that they are interchangeable with Elastimold K655 BLR elbow interfaces and electrical ratings. Bushings shall have a 5/8" threaded hole. Bushings with studs installed are not acceptable.

5.3 Each bushing shall have a cap to prevent the entrance of moisture or contamination during shipping and storage. The bushings shall be protected against damage during shipping and temporary storage with a wood or metal cover that is securely fastened to the transformer.

5.4 One parking stand (four total) shall be welded on the wall near each bushing, complete with stainless steel or copper-faced steel ground pads with a 1/2"-13 UNC tapped hole 7/16" deep. The threads shall be coated with oxide-inhibiting compound. The parking stand shall accommodate an Elastimold standoff plug.

6. Tank Ground

6.1 Tank grounding provisions shall consist of four (two per end) copper-faced steel pads 2" x 3-1/2" with two 1/2"-13 UNC tapped holes 7/16" deep, 1-3/4" apart on the wall of the transformer near the base per ANSI 57.12.10, Section 5.5. The ground pads shall be mounted in the vertical position 34-1/2" center to center. All tapped holes for ground connections shall be coated with oxide-inhibiting compound.

* The requirement for 25 kV class bushings is for interchangeability with the majority of Seattle City Light's distribution system equipment.

7. Tank, Cover, and Handhole

7.1 The tank shall be constructed per ANSI C57.12.10, Section 5.8.

7.2 The tank shall be designed for an operating pressure of ± 8 psig minimum. The transformer shall be tested by the manufacturer as follows:

(a) 7 psig negative for 30 seconds. Permanent deformation of the metal shall constitute failure.

(b) 7 psig positive for 6 hours per ANSI C57.12.24, Section 8.5.1. Permanent deformation of metal or leaks shall constitute failure. It is strongly suggested talc or chalk powder be applied to all welds, seams, valves and plugs for leak detection. Removal of the powder prior to shipment is not required. It is also suggested the plug in the drain valve be removed during leak testing.

7.3. The maximum operating pressure (positive and negative) shall be indicated on the nameplate per ANSI C57.12.10, Section 5.8.1.

7.4 The main cover with two handholes, shall be welded per ANSI C57.12.10, Section 5.8.3; one handhole at the primary end and one at the secondary end. The handhole and cover shall also meet the requirements of the latest revision of Seattle City Light Material Standard Supplement Number 0038.nn. The handholes shall have a net opening of 200 to 400 square inches. The handhole cover with a one piece (no dovetail) reusable gasket shall be through-bolted to a raised flange which is welded to the transformer cover. Bolts shall be silicon bronze or stainless steel. If the gaskets are cork and synthetic rubber (BUNA-N) or similar material, they shall be installed without adhesives. The cover shall have means for breaking the seal (seal-breaking bolt or similar). Handholes will be opened for receiving inspection. Gaskets damaged will be replaced by the manufacturer at the manufacturer's expense. It is strongly suggested that the surfaces that mate with the gasket be painted with an epoxy paint allowing adequate cure time before installation of the gasket.

7.5 The oil fill shall consist of a 2” NPT nipple welded in the center of one of the handhole covers complete with a brass pipe cap. A liquid thread compound shall be used on the pipe joint. Teflon tape is not acceptable.

7.6 A pressure relief device shall be per ANSI C57.12.10 Section 5.8.1 except it shall be installed in the middle of one of the handhole covers.

7.7 The covers and all appurtenances shall be designed to shed water.

7.8 The transformer finish shall consist of three coats of alkyd enamel or equal to a minimum thickness of 5 mils when measured with a magnetic thickness gage. An undercoat over the regular finish shall be applied to the tank bottom and extend up the sides 12" above the bottom of the base. The undercoat shall be a minimum of 10 mils (reference: ANSI C57.12.40, Section 9.4, Network Transformers).

8. Accessories

The transformers shall be equipped with the following accessories:

8.1 Taps. The transformer shall have a full-capacity, de-energized tap changer in the high-voltage windings for 27,100 volts, 26,400 volts, 25,700 volts, 25,000 volts, and 24,340 volts per ANSI C57.12.10, Section 5.1.1.

8.2 Liquid-Level Indicator. A magnetic liquid-level indicator shall be per ANSI C57.12.10, Section 5.1.2. The float mechanism shall have a stop that prevents the float from going over the high mark due to oil sloshing during transit. It is strongly suggested the float mechanism be within arm’s length of the handhole as this is a frequent receiving problem.

8. Accessories (Continued)

8.3 Liquid Temperature Indicator. A dial-type thermometer shall be per ANSI C57.12.10, Section 5.1.3. Unless other provisions are made, the indicator shall have contacts necessary for future fans.

8.4 Pressure-Vacuum Gage. A pressure-vacuum gage shall be per ANSI C57.12.10, Section 5.1.4.

8.5 Drain and Filter Valves. Drain and filter valves shall be per ANSI C57.12.10, Section 5.1.5 except the valve shall be installed on a pipe nipple welded to the tank. A liquid thread compound shall be used on the pipe joint. Teflon tape is not acceptable.

8.6 Lifting, Moving, and Jacking Facilities. Lifting, moving, and jacking facilities shall be per ANSI C57.12.10, Section 5.3, except **additional jacking bosses shall be provided**, one in each corner, 9" ± 1/2" above the ground, for jacking with hydraulic transformer jacks.

8.7 For seismic anchoring systems, the base rails shall be designed to be welded to beams imbedded in the concrete pad. The details of the base rail shall be included on the outline drawing or on a separate drawing. The center of gravity shall be shown on the outline drawing.

8.8 Fans and Controls. **Provisions** for future fans and automatic controls, controlled from the top oil temperature shall be per ANSI C57.12.10, Section 5.9. “Provisions” shall include all necessary equipment, cabinets, wiring and mountings except fans and controller. The fan power will be 120/240V, 1Ø and provided from an external source.

9. Short-Circuit Capability

The manufacturer shall submit certified test data proving its design has performed satisfactorily when tested in accordance with ANSI C57.12.90, except “Proof of Satisfactory Performance” shall include compliance with;

(a) The visual inspection requirements of Section 12.5.1.

(b) The dielectric tests of Section 12.5.2.

(c) The wave shape of terminal voltage and current requirements of Section 12.5.3.

(d) The leaking impedance allowable variations of Section 12.5.4.

(e) The low-voltage impulse test of Section 12.5.5.

(f) The excitation current requirements of Section 12.5.6.

In addition, the manufacturer shall supply proof that the design tested is essentially the same design being supplied.

10. Losses

Transformer losses will be evaluated at the full load OA rating at 75° C on the following basis:

(a) Core losses at $5,900.00 per kW

(b) Load losses (windings) at $2,600.00 kW

(Total Losses = Core Losses + Load Losses)

Losses shall be provided at the 55° C OA rating and the 65° C OA rating.

11. Nameplate

A stainless steel diagrammatic nameplate shall be affixed to a standoff bracket using stainless steel fasteners. The nameplate standoff bracket shall be welded to the tank end or side wall, approximately 5 feet (1.5 m) above the base. The nameplate shall:

(a) State all information per ANSI C57.12.00, Nameplate C.

(b) Include the date (year) of manufacture.

(c) State the operating pressure as required in ANSI C57.12.10, Section 5.8.1.

(d) State "Contains less than one ppm PCB at time of manufacture."

12. Transformer Oil

12.1 Oil. The transformer shall be shipped with the proper quantity of inhibited insulating oil in the tank.

12.2 Oil Preservation. Oil shall be self-contained in a sealed transformer tank. No external preservation systems, such as conservator or nitrogen bottles, will be accepted.

13. Electrical Tests

The minimum following electrical tests shall be made by the manufacturer in accordance with ANSI C57.12.90 and/or NEMA TR1.

(a) Resistance.

(b) Ratio.

(c) Polarity and phase relation.

(d) Exciting current at 90 percent, 100 percent, and 110 percent of rated voltage.

(e) %R, %X, X/R

(f) No load loss at rated voltage.

(g) Load loss at the OA 55° C rating and at the OA 65° C rating.

(h) Regulation at 100 percent PF and 80 percent PF.

(i) Temperature rise at 65° C rating.

(j) Applied potential.

(k) Induced potential.

(l) Impulse test.

(m) R.I.V. test per NEMA TR1-0.03 except test voltage shall be 17.4 kV, L-G for one minute. The R.I.V. level, not to exceed 250 microvolts, shall be recorded and reported.

14. Data to be Submitted with Bid

14.1 All bidders shall submit with their proposal the data listed below. They shall submit a description of any changes, additions, or exceptions to the specification they propose, together with reasons for the departure. Product evaluation and conformance to specification will be determined on the basis of information submitted. The drawings and data furnished must be in sufficient detail and clarity to enable making a complete and positive check with the technical provisions of the specification.

(a) Outline drawings with overall dimensions.

(b) Details of the high- and low-voltage bushings. The manufacturer's name and catalog number will suffice, provided no exceptions are requested.

(c) Average core losses, load losses (windings), and total losses at full load OA rating at 75 C.

(d) That the transformer is a 55/65° C rise design.

(e) A copy of an instruction book or an outline of all required maintenance. Maintenance requirements will be evaluated.

(f) Regulation at power factors of 100 percent and 80 percent.

(g) Impedance of windings at rated load expressed in percent of rated voltage.

(h) Information concerning details of construction tank materials and tank finish. Generally, a product brochure will suffice.

(i) Make, specification, number of gallons, and weight of oil.

(j) Detailed information regarding the short-circuit capability. See Section 9 of this specification.

(k) State all electrical tests given to the transformers at the factory.

(l) Total weight of completely assembled transformer, including oil.

(m) Provide information on each type of transformer insulation material used. (Generally, a product brochure will suffice.)

(n) Average audible sound level for the OA ratings at the 55° C and 65° C ratings.

14.2 Comparison of bids for determining the lowest and best bid will include, but not be limited to, the following: (a) the price and cost of losses, (b) drawings, data, and other information required in Section 14.1, (c) maintenance requirements, including labor and material (d) the bidder's qualifications including service facilities for performing future maintenance, and (e) differences in design and construction that may affect the cost of installation, operation, and maintenance, space requirements and environmental factors such as appearance and operating sound levels.

15. Data to be Supplied by Manufacturer

15.1 As soon as possible after award of contract, but not later than 45 days thereafter, the manufacturer shall furnish for approval three copies of drawings showing all of the basic design details.

Approval of the manufacturer's drawings by the City shall not relieve the manufacturer of any part of its obligation to meet all of the requirements of these specifications nor of the responsibility for the correctness of such drawings, diagrams, and schematics.

15.2 Thirty days prior to delivery, the manufacturer shall furnish:

(a) Six copies of outline dimensions of transformers with all accessories, showing the center of gravity.

(b) Six copies of details of the base rails, if not included with the outline drawing. These are required for design of seismic anchoring systems.

(c) Six copies of transformer nameplate.

(d) Six copies of an instruction book covering installation.

(e) Six copies of complete parts list for the above equipment. The list shall include the part numbers for all components necessary for fan operations.

15.3 Six copies of the certified test reports noted in Section 13 shall be furnished attached to the invoice for payment.

16. Guarantee and Penalties

16.1 Any transformer failing, due to defective design, material, and/or workmanship, within two years after being energized or 30 months after delivery, shall be repaired or replaced without cost to the City of Seattle, City Light Department. Any defect in design, material, and/or construction discovered within this period shall be corrected on all transformers furnished on this order at the manufacturer's expense, either by repair or replacement.

16.2 The manufacturer will be assessed a penalty for transformers delivered that exceed the total loss value stated and calculated on the bid proposal.

Total loss value = core loss x $5.90/watt + load loss x $2.60/watt.

The penalty shall be the difference between the total loss value delivered less the total loss value in the bid proposal. Tolerances will be allowed in accordance with ANSI C57.12.00, Section 9.3, Table 18, except "on a given order" shall mean transformers of a given size and voltage; i.e., one line item.

16.3 Upon delivery, all transformers will be tested and inspected. Transformers that fail to pass the tests will be returned to the manufacturer. The cost of **retesting** transformers that have been returned to the manufacturer for correction of defects will be charged to the manufacturer.

REFERENCES:

ANSI	C57.12.00
"	C57.12.10
"	C57.12.24
"	C57.23.40
"	C57.12.90
NEMA	TR1

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